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TMAP Design Cards for Technology-Mediated Audience Participation in Live Music

Oliver Hödl, Fares Kayali, Geraldine Fitzpatrick and Simon Holland

Abstract Historically, audiences have had various ways to participate in live music performances, including clapping, dancing, swaying, whistling, and singing. More recently, mobile and wireless devices, such as smartphones have opened up powerful new opportunities for audience participation. However, design for technology-mediated audience participation (TMAP) can be challenging: musicians and audiences have different demands, as does the coherence of the music, and group needs can vary widely. Thus, effective TMAP design requires the balancing of knowledge from diverse perspectives and must take into account the needs of diverse roles in creating and supporting performances. This chapter focuses on the process of creating and evaluating a set of design cards to support the interaction design and evaluation of TMAP systems. The cards are based on a previously created descriptive framework for supporting interaction design and evaluation in this challenging area. We discuss the conception and development of the TMAP design cards in some detail, and present an empirical study to evaluate their practical usefulness. Particular attention is paid to the ability of the cards to support finding ideas, changing ideas, and examining ideas from different perspectives.

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1 Introduction

Audience participation in live music is not new: audiences have long been able to clap, dance, sway, whistle, shout and sing while listening to live music. However, new technologies have opened up new opportunities for audiences to participate in live musical performance. Interaction design for this area is particularly demanding: amongst other things, it requires balancing the interests of diverse stakeholders such as musicians, audiences, managers, visual artists and audio engineers. In order to support design for technology-mediated audience participation in live music (hereafter abbreviated to TMAP) we created a set of cards to support the design of TMAP systems. The cards are based on a previously synthesised descriptive framework for supporting the interaction design and evaluation of such systems.

This chapter focuses on the conception and development of the TMP design cards based on the descriptive framework, and presents an empirical study of their potential to support design. Particular attention is paid to the ability of the cards to support ideation, changing initial ideas, and facilitating the examination and re-examination of ideas from different perspectives.

The chapter starts by outlining selected representative examples of technologically mediated audience participation in live music, and then briefly considers various design cards for other domains. The descriptive framework that forms the basis for the TMAP design cards is then outlined. These sections set the scene for the two principal focuses of the chapter: the design process for the cards themselves, and the process of their evaluation. The chapter concludes with lessons learned both for music interaction and HCI and implications for future work.

2 Background

2.1 Technologically mediated audience participation

Approaches to audience participation in live music are manifold. Some date back to Mozart's times using dice (Mozart 1793) or other everyday objects. More recent examples have exploited newer technologies to allow wider, more detailed, or deeper levels of interactivity. For example, *Radio Net* from 1977 used the analogue telephone network to involve thousands of people in a networked performance (Neuhaus, 1994). Freeman (2005) wrote a special composition for chamber

orchestra and audience. In his piece *Glimmer* the musicians play music based on the audience using light sticks to collaboratively create instructions. Kaiser et al. (2007) presented a system that allows the audience in a dance club to transmit visual material to a VJ (Visual Jockey), who selects and creates live visuals according to the music. Other researchers in nightclubs used biofeedback of the audience for an automated DJ system. *MassMobile* (Weitzner et al., 2012) is a smartphone application for audience participation using a client-server architecture. This system allows a wide a range of features to be adapted for participatory performance, for example voting to change lighting configurations or, with a suitable smartphone interface, to allow collaborative improvisation among spectators.

The various approaches can and do have widely contrasting motivations: in some cases an artistic concept may be motivating the use of technology; in other cases a technology may have inspired researchers to investigate a new form of participative performance. Regardless of motivation, the degree of success or failure of TMAP systems or events typically depends on issues that involve at least three areas of concern: artistic creation, engineering and interaction design. Taken together with the need to balance interests of diverse stakeholders, as outlined above, the design processes in this area can be very challenging.

While many artists and researchers have experimented with technologically mediated audience participation with varying degrees of success, by contrast little research has been carried out on the investigation and development of new design practices, tools and methods to support the conceptualization and creation of technologically-mediated audience participation systems and events.

One explicit system for analyzing TMAP in live music is presented by Mazzanti et al. (2014). They propose *six metrics* to describe and evaluate concepts for participatory performances. Their approach addresses aspects of participatory performances both conceptually and technically (e.g. system versatility, audience interaction transparency, audience interaction distribution). However, this system is intended to support evaluation rather than design. Consequently, given the limited extent of previous research on supporting the design of technologically mediated audience participation, an alternative reference point for the research described here was provided by existing design cards for other domains.

2.2 Design cards for other domains

To support design processes in other domains, various sets of design cards have been developed in the past. Figure 1 shows representative examples:

- IDEO Method Cards (IDEO 2002)
- kribbeln im kopf creative sessions (Pricken and Klell 2006)
- Intangibuild (Keaney 2003)
- IdeenRausch (Ebertz 2009)

- Innovative Whack Pack (Von Oech 2003)
- Design with Intent (Lockton 2013).

Representative examples of research in this area include Hornecker (2010) and Lockton (2013) who transferred their design frameworks into cards. Hornecker built her design cards on a conceptual framework for tangible interaction. Her set contains 26 cards with questions and figures structured in four categories: tangible manipulation, spatial interaction cards, embodied facilitation and expressive representation. Lockton's *Design with Intent* card set contains 101 patterns for influencing behaviour through design. He structured his set in eight lenses, namely: architectural, error proofing, interaction, ludic, perceptual, cognitive, Machiavellian and security. Each card shows a pattern name, a provocative question and a particular example as one possible solution to the question. The card decks systems of Hornecker and Lockton provided useful sources of inspiration for the TMAP design cards.



Fig. 1. Different cards as tools for inspiration, guiding and shaping during design: (1) IDEO Method Cards, (2) kribbeln im kopf creative sessions, (3) Intangibuild, (4) IdeenRausch, (5) Innovative Whack Pack, and (6) Design with Intent.

3 The TMAP Descriptive Framework

As previously noted, the TMAP design cards were developed based on the existing TMAP descriptive Framework. Figure 2 shows a part of this framework. The TMAP Framework (Hödl, 2016) was developed iteratively using qualitative and quantitative methods in a series of design and case studies to explore and describe

the field of technologically mediated audience participation. At the point of its use described in this chapter, the TMAP Framework contains 178 entities, hierarchically structured on four levels. The root of this four-level tree contains the three main categories *Motivation*, *Influence* and *Interaction* (Figure 2). Each of these *main categories* at the top level splits in a number of *categories* and then *sub-categories* at the second and third levels respectively to address and structure particular areas of application. The fourth and lowest level of the hierarchy holds 116 *design aspects* spread over the various categories. These design aspects are each illustrated by concrete examples for application. This hierarchy has many analytical uses, but it also has many diverse potential uses in provoking designers to consider new approaches and to re-assess existing ideas. A short example walking down the hierarchy from one of the main categories to a set of relevant design aspects may help to suggest ways in which such paths could be used to provoke or question ideas.

For instance, the main category *Influence* on the first level (Figure 2) asks the designer: What is the target of participation (i.e. what general aspect of the performance is to be influenced by audience participation)? The second level suggests categories such as *Musical* and *Visual*, etc. as possible more specific aspects of the performance to be targets of participation. The sub-categories under *Musical* at the third level include *Temporal*, *Sound*, *Structural* and *Conceptual* to refer to particular aspects of music. Finally, the fourth level provides concrete design aspects such as *meter*, *beat*, *rhythm* or *tempo*, which are all time-related (or Temporal) aspects of music.

All other 178 entities of the TMAP Framework are structured in a similar way but cover different design aspects of an interactive performance. The whole framework including a comprehensive description of its development process can be found in Hödl (2016).

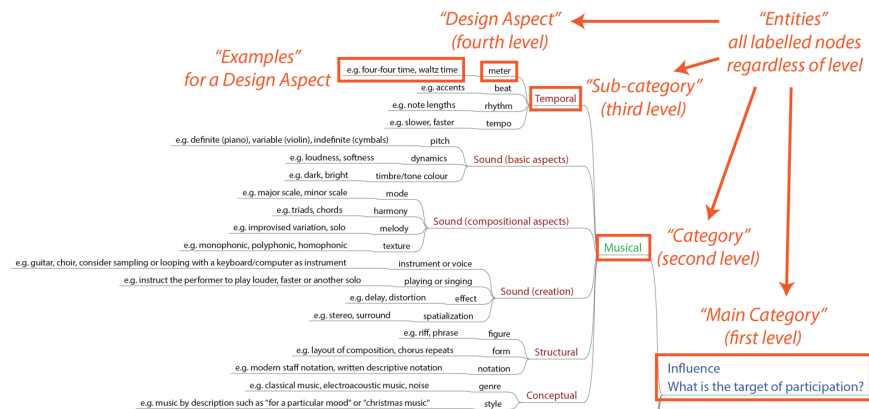


Fig. 2. Framework structure and terminology for one main category of the TMAP framework.

4 TMAP Design Cards

The process of moving from a conceptual framework to a practical, physical set of Design cards well suited to supporting collaborative processes of analysis and design, and useful for building understanding between different stakeholders (Hödl, 2016) poses numerous research problems. The TMAP Design Cards were developed in two steps, both of which are described in detail below. Firstly we reviewed and prepared the TMAP Framework in a process designed to support mapping appropriate elements onto the design cards. Secondly we created a set of 46 TMAP Design Cards plus 3 instruction cards. Two experts in design card development from other research areas were recruited as part of a design workshop to support the process of developing the cards. Both experts were post-doctoral researchers with backgrounds in HCI and design. One had a focus on game design and the other specialised in interaction design. The two principal stages of card design were carried out as described below.

4.1 Initial mapping of the TMAP Framework to card concepts

As already noted, the starting point for this step was the TMAP Framework with its 178 entities as outlined above. All entities in the framework were reviewed step by step and the experts who were included in this process gave immediate feedback. The feedback focused on issues such as: terminological and wording issues, intelligibility problems, missing aspects, and potential inconsistencies. More generally, the review considered how best to proceed to design cards based on the framework. During this review process, four principal decisions were made before considering any detailed issues of visual design and layout.

The first two decisions were influenced by design decisions represented in cards for other domains, as presented in Figure 1. The first decision was to clearly identify each card as belonging to one of a small number of different high-level general categories. The initial choice of high-level categories for the TMAP cards was straightforwardly achieved by starting with the three main categories from the TMAP framework - *Influence*, *Motivation*, and *Interaction* – although the choice of high-level categories for the cards was expanded later in the design process, as noted below in the discussions of *Roles* and *Recommendations for Usage* respectively).

Secondly, in line with other sets of design cards, we decided to constrain the total number of cards in the pack to what seemed to be a representative yet manageable number (by way of comparison, the IDEO Method Card pack contains 51 cards). Consequently, in order to avoid too thin a pack, we decided to use a separate card for each *sub-category* (e.g. *Temporal*) of the TMAP Framework, yielding 46 design cards, rather than stopping at the *category* (E.g. *Musical*, *Visual*, etc.)

which would have yielded just 15. At the same time to avoid to bloated a pack, we avoided having a card for each aspect (which have would yielded an unwieldy 178 design cards). See Figure 2 for examples of categories and sub-categories as used for the cards.

The third decision originated from an idea of the game design expert to use the concept of different (imaginary) *roles* when using the design cards. Accordingly, we promoted the category *Role* (from the main category *Interaction* which already existed in the TMAP Framework) to a high level category for the purposes of card design.

The fourth decision concerned how to organise information concerning the lowest level of the framework, the *design aspects* (e.g. *meter*, *beat*, etc.) – and how to use the front and the back of the cards to enable information hiding and progressive disclosure were appropriate. The decision made here was to use the front to display the main category, category, and sub category (which act in effect as design questions), and to use the back to display the design aspects (which may be viewed as possible answers or design choices). The rationale was to allow users to more easily control processes of progressive disclosure and information hiding.

4.2 Drafting Design Cards

After reviewing the TMAP Framework and making key decisions about how to map the elements of the framework onto design card concepts, it was essential to consider finely detailed issues of visual design and layout for the cards. This forms the topic of this subsection.

Three alternative draft designs for the cards were considered and compared. For two of these drafts we generated the front and the back of an example card, for the third, only the front was drafted. Figure 3 shows all three drafts and how they influenced the final card design. Table 1 shows an overview of how the various elements of the framework were used in the design cards.

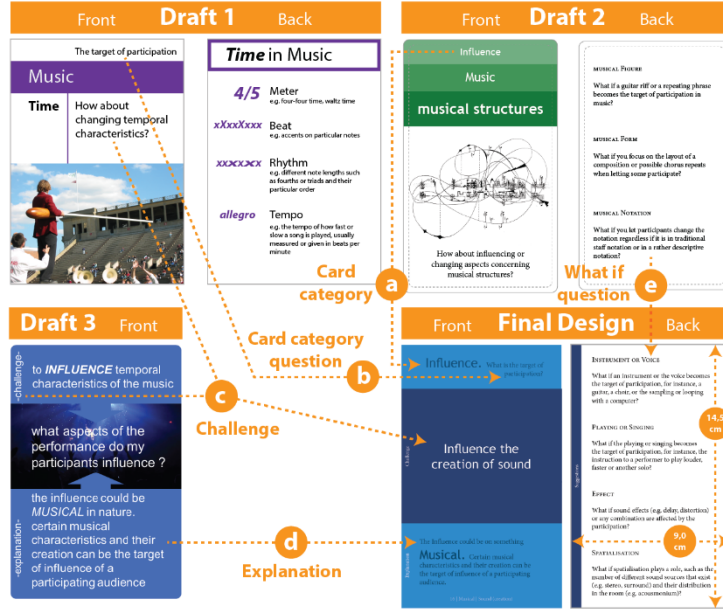


Fig. 3. The final design of the TMAP Design Cards, and three drafts on which this design was based.

TMAP Framework	TMAP Design Cards
Main category (+question)	Card category (+question)
Category	Explanation
Sub-category	Challenge
Design aspects (+examples)	Suggestions (+what-if-questions)

Table 1. Entities of the framework and their use for the design cards.

For the header or top section of the final TMAP Design Card, we combined the ideas of draft 1 and 2 to show the card category (e.g. *Influence*) plus a short explaining sentence (i.e. What is the target of participation?). The idea behind this design was to visually emphasise the *Card category* (a) but to support the understanding with an additional *Card category question* displayed in smaller letters (b).

In the example card shown in Figure 3, the main section in the middle of the front side of each card shows what we refer to as a *Challenge* (labelled ‘c’ in the Figure). This *Challenge* is unique for each card, and is based on the corresponding sub-category of the TMAP Framework. The idea to frame these elements as challenges came from draft 3, as illustrated in Figure 3. The placing of the challenge in the main section in the middle of the front side of each card was derived from draft 1. The content of the bottom of the front side of each card inspired by draft 3. Instead of simply using the name of a category (e.g. *Music*) to label cards of the same category, as in draft 1 and 2, we framed this categorisation as the *Explanation*, and used a longer description to characterise the category (see ‘d’ in Figure 3).

The design of the back of each card was largely inspired by draft 2, with a framing of the examples of each design aspect as *What-if-questions* - suggesting a possible solution to the challenge on the front side. Answering the challenge and explanation on the front side of each card, we called the content on the back of the card *Suggestions*. As each sub-category of the TMAP Framework has 2 to 4 design aspects, every card has also 2 to 4 *Suggestions* corresponding with the design aspects, but formulated as *What-if-questions*.

We decided to create the TMAP Design Cards bigger than typical palm-sized playing cards, setting on a size of 9.0 x 14.5 cm. This followed the precedent of other design cards (IDEO 2002, Pricken and Klell 2006, Lockton 2013) but also reflected the amount of text needed on our cards, especially for the *Suggestions* on the backside.

For all cards, we added a footer at the bottom of each card showing a running number, the category, and the sub-category. Figure 4 shows an example front (upper row) and back (lower row) for three card categories. In order to facilitate a clear distinction between cards of different high-level categories, we chose a different colour for the *role* (red), *motivation* (yellow), *influence* (blue), and *interaction* (green). The fifth card category in Figure 4 (leftmost) is for the *recommendations* (purple) how to use the cards, as we will describe next.

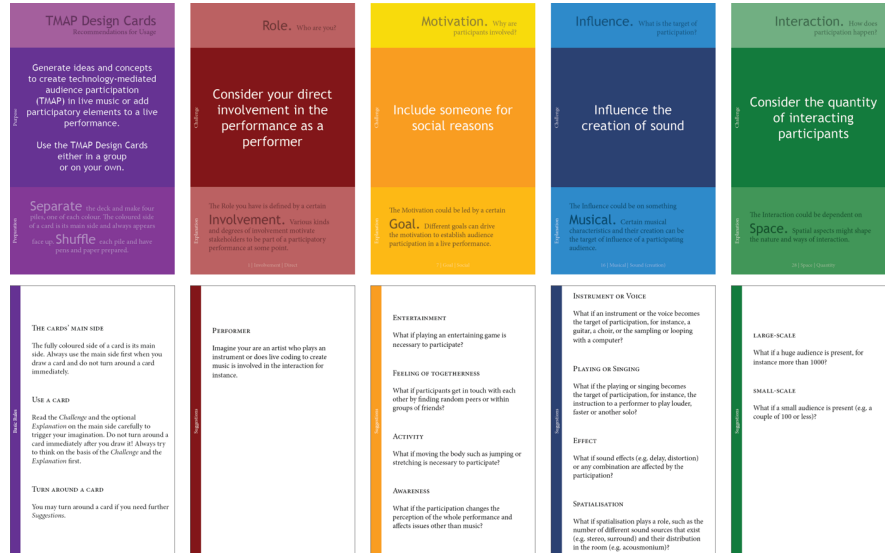


Fig. 4. An example front and back of three design card categories.

4.3 Recommendations for Usage

To complete the development of the TMAP Design Card we considered and formulated instructions for their use. We called these instructions *Recommendations for Usage* to emphasise their non-binding character, as they should rather guide and inspire the design processes around TMAP rather than strictly control them. The general recommendation for use of the cards was framed as, “Generate ideas and concepts to create technology-mediated audience participation (TMAP) in live music or add participatory elements to a live performance. Use the TMAP Design Cards either in a group or on your own.” As preparation before design sessions, we suggested, “Separate the deck and make four piles, one of each colour. The coloured side of a card is its main side and always appears face up. Shuffle each pile and have pens and paper prepared.” Finally, we formulated three basic *rules* to use the cards during a design session:

- The cards' main side: The fully coloured side of a card is its main side. Always use the main side first when you draw a card and do not turn around a card immediately.
- Use a card: Read the *Challenge* and the optional *Explanation* on the main side carefully to trigger your imagination. Do not turn around a card immediately after you draw it! Always try to think on the basis of the *Challenge* and the *Explanation* first.

- Turn around a card: You may turn around a card if you need further *Suggestions*.

To make the TMAP Design Cards usable either collaboratively in a group or for a single person, we formulated two modes. The *Multi Person Mode* suggests as preparation, “Every person draws a *Role* card (red) which defines the person’s role. Everybody keeps thinking for a moment about the role and refines it quietly.” along with the additional hint, “If the group size extends to six people or more, we recommend to make smaller groups of three or four people each.” For the conduct of a design session, we proposed:

- First round: Everybody draws one card in addition to the *Role* card. The person who starts takes an *Influence* card (blue), the second one an *Interaction* card (green), the third one a *Motivation* card (yellow), the fourth an *Influence* card, and so on. Now everyone tries to create an idea based on the *Challenge* written on the card and the further *Explanation* below. Do not turn around a card immediately but do so if you need further *Suggestions* while you create your idea. This is followed by a group discussion where everyone contributes ideas based on their own cards. Use pen and paper to make notes and sketches.
- Further rounds: After the first round, further rounds may follow. At this point, cards may be discarded to draw a new card and if desired even from another colour. Discarded cards may be either fully discarded from the game (of course only for this session) or discarded for later use by dropping it on the related sketches or notes of the finished previous round.

The *Single Person Mode* works similarly, however, with some alterations starting with a different hint, “In *Single Person Mode* we recommend to use pen and paper to sketch your ideas instead of just thinking.” The actual alteration for the course of a design session is, “You may draw a *Role* card (red) but you may also define a role on your own. Act as if you were doing a session in a group but draw all cards by yourself. First, draw an *Influence* card (blue), then an *Interaction* card (green), then a *Motivation* card (yellow), then another *Influence* card and so on. However, do not draw more than one card at once. Every time when you draw a card, think thoroughly about the *Challenge*, read the *Explanation* and finally turn the card to make use of the *Suggestions*. Always make notes and sketches to write down your ideas before you draw another card.”

To align these instructions with the other cards, we designed them in the same way but gave them a different colour (purple), as already illustrated earlier showing exemplary cards in Figure 4. In total, we created three purple *Recommendation for Usage* cards, one for general instructions and two for the different modes. In the end, we had 3 recommendation cards and 46 design cards: 6 role, 6 motivation, 12 influence, and 22 interaction. All cards are available in Hödl (2016).

5 Evaluation of the TMAP Design Cards

To explore the potential of the TMAP Design Cards, we gave sets of cards to four groups of three students each in a seminar called *Gameful Design* at the Vienna University of Technology. We chose this particular seminar as its goal was for students to learn and understand gameful design methods by trying out different design strategies and challenges. The seminar was for Masters' students. Thus, students could be reasonably expected not only to be qualified but also motivated to test the TMAP Design Cards. We asked them to form groups, ideally with each group having at least one musically trained member. Fortunately, there were enough musically trained students in the course that we could fulfil this obligation. The students used the cards to generate ideas for TMAP in self-organised workshops. They documented the design sessions (Figure 5) and critically reflected on the TMAP Design Cards, and on the whole process of using them. Finally, all groups presented their results in form of short video sketches and reported back about their experience from the design sessions.

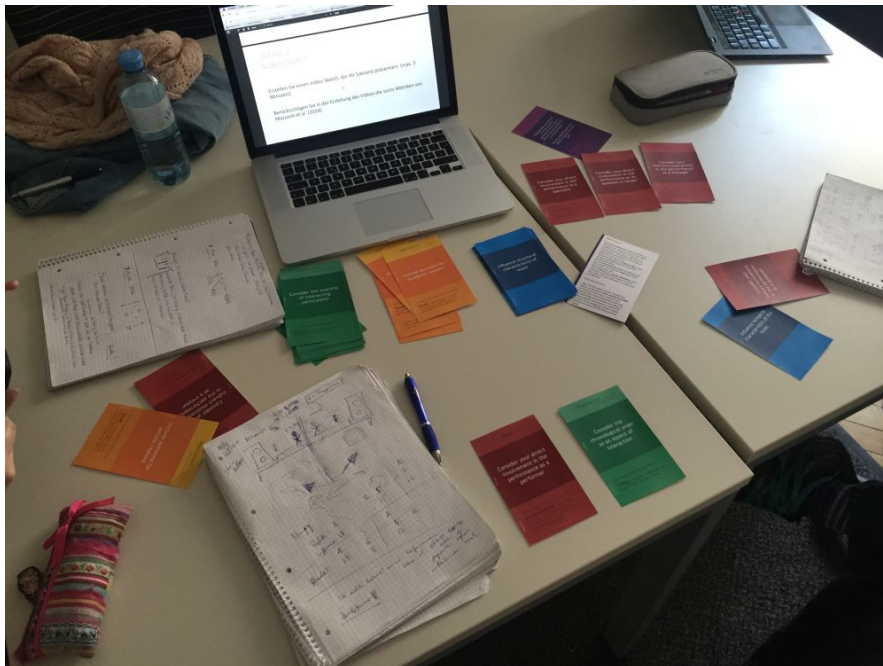


Fig. 5. Design session of three students using the TMAP Design Cards.

The ideas for technology-mediated audience participation that the groups designed were of course the immediate concrete outcomes of using the design cards. However, the analysis of the *students' reflections* was the main interest of this

study from the point of view of evaluating the usefulness of the cards. Nonetheless, the audience participation ideas that the groups created provide illuminating contexts for the critical reflections on the design process. Consequently we briefly present here the ideas generated by all four groups.

The first group created a *Rap Battle*. They described it as a hip-hop performance with two competing rappers on stage, in which the audience decides who wins, as determined by the audience's physical activity. Figure 6 describes the concept briefly showing three sketches:

1. two rappers compete on stage;
2. individual technical devices measure the activity of the spectators;
3. the rapper with more active fans wins the battle.



Fig. 6. Idea of the first group: *Rap Battle*.

The second group invented the *Battle for Gødtfrey*, an interactive smartphone app to augment the performance of a fictional *Viennese medieval folk/metal band*. See Figure 7 for sketches and a brief description of the concept:

1. spectators create an avatar prior to the concert;
2. all avatars appear on a projection on stage;
3. during the performance avatars enter an epic battle between the forces of light and evil that decide which course their concerts take.



Fig. 7. Idea of the second group: *Battle for Gødtfrey*.

The third group presents *Helsinki Rising*, that is an interactive dance floor for DJ performances. The basic idea is to use floor tiles that can change colour and measure the collaborative audience activity. The DJ can either play a normal set or use the interactive dance floor for mini games. Figure 8 explains the basic concept using three sketches:

1. at the beginning the interactive dance floor is deactivated (*Bhne* means stage, the tiles are the dance floor);
2. the DJ can start a mini game to encourage audience participation;
3. spectators can go to sections of the dance floor to trigger events.



Fig. 8. Idea of the third group: *Helsinki Rising*.

The fourth group describes *FRLFTMSK* which stands for the German word *Freiluftmusik* without vowels. Freely translated it means open air music and uses a smartphone app to record every day sounds later used in a DJ performance. See Figure 9 for sketches and a short description that explains this idea:

1. use a smartphone app to record any sound;
2. upload the sound to a DJ's sound collection;
3. the sound may be used in the next performance of the DJ.



Fig. 9. Idea of the fourth group: *FRLFTMSK*.

5.1 Results of Analysing Critical Reflections on Design Sessions

We analysed the students' written reports thematically to identify and categorise issues concerning the design cards or the process itself. We present these results in detail according to four themes we identified. These four themes were: issues with terminology and roles; whether participants used the cards as recommended or not; how the design cards affected the idea finding and changed their thinking; and finally improvements in the cards or process as suggested by the students.

5.1.1 Issues with Terminology

Four students explicitly reported they were confused and could not really understand what the challenge on the front side was inviting them to do. One student suggested formulating the descriptions “more direct and concise”.

Another student said the descriptions were complicated and disruptive when thinking about ideas. However, the same student said this should not be a problem for people who are familiar with music and who are used to the terminology. On a related note, another student asserted: “the cards seem to require some musical knowledge in order to be useful.” These students had problems because of their lack of expertise, as they themselves identified. However, by contrast, being a non-expert and having trouble understanding a card in a straightforward way appeared to be helpful according to one student: “The cards incentivise thinking about the combinations one gets, instead of skipping over cards that do not seem to make sense”.

5.1.2 Issues with Roles

The imaginary roles, to which students were randomly assigned, were seen as both enriching and challenging. While some students reported the role helped them to get a different view, others saw contradictions between their role and other cards.

Several students discussed the roles explicitly and in particular, they mentioned the role card *Manager*. For example, one student reported that *Manager* card constrained exploring interesting combinations with other cards and thinking up potential ideas, while another student reported he came up with a novel idea precisely due to thinking of the managerial role. One student said, “combinations [of cards] seemed a bit confusing, like the manager thinking about spatial movement”.

In two reported cases, students excluded this card after the first round as they did not know what to do with it and found it restricted thinking. One group decided to choose roles by themselves in the second round after not being satisfied with the random assignment of roles in the first round.

5.1.3 Issues with Recommendations

According to the students' reflections, they mainly used the cards as recommended. However, in relation to issues with the role cards, they reported that they changed roles on demand when certain roles were too restrictive to encourage ideas.

Not only for role cards but also other cards, students decided to use the usage recommendations a flexible way. They reported that they swapped cards, restarted the design process, or even excluded cards from the set. These self-managed changes helped them during the idea finding process to use the cards flexibly and productively.

Concerning the actual use of the cards, some students gained enough inspiration from the challenges alone (on the front of the cards) while others liked to turn them around and read all suggestions carefully.

5.1.4 Idea Finding

We identified several ways in which the cards influenced idea finding during the design process. According to three statements, the cards helped the students to see a design through other people's eyes and to generate new ideas catalysed by the new perspectives of a previously unconsidered role. In contrast to the problems with the manager role card mentioned earlier, this particular card and the role concept more generally was mentioned positively in the context of idea finding. One student reported that the manager role inspired him to think of using smartphone statistics.

Two students commented on idea finding in relation to the feature of the card design that gave each card a challenge on the front side and a suggestion on the back. One observed that they rarely looked at the suggestions as they were already inspired by the challenges. Another one reported that the suggestions on the back were decisive for their design ideas and moved the discussion forward.

In one case, the process of shared idea finding within the group seemed to distract one individual from considering roles. This student reported that the distraction of the ideas raised by others made him “subconsciously abandon my role card and just think about the interaction card”.

Another student reported that his group had had a basic idea, but most of the cards did not fit and so they decided to completely change the cards and restart a round. The same student also said that a new card he was dealt made the group discuss “the spatial distribution of interacting participants”, which was completely new to their idea. He added that they liked how the cards pushed their thinking without suggesting a particular design solution. The cards not only triggered ideas but also changed participants' thinking, as we describe next.

5.1.5 Change Thinking

Related to idea finding, but more focused on the overall process, were reports about how the design cards *changed* thinking throughout the design sessions. In particular, students reported that the design cards became helpful later in the process when they already had a basic idea. Indeed, two students explicitly said that the cards were not helpful at the beginning but were helpful later during the design session when “fleshing out an already existing idea”. One student mentioned that the cards were useful when their creative thinking “came to a standstill”. Another reported that “the cards were less helpful when trying to come up with a new idea. However, the cards were useful when filling out details and discovering things

about the design that were not apparent at first glance.” Finally, one student said, “For what they [cards] also proved to be very useful was viewing an already existing concept through a new facet/point of view.” These observations suggest that the students often undertook late changes of aspects of their designs, inspired by use of the cards.

Other students reported early problems with understanding aspects of the cards but resolving these problems as they became familiar with them. For example, two students said they had troubles initially using the cards, but by reading the texts “carefully and thinking about them, it became more clear what to do, though”. Another student reported that the word ‘temporal’ as a challenge did not make sense at the beginning but in the end triggered the idea not to do the interaction during the performance but prior to the performance.

There was one case where the cards were mentioned as not helpful in changing thinking: the group very early had an outline idea, and said they found it hard to move away from this idea, even by using the cards.

5.1.6 Suggestions for improving the cards

Finally, students made suggestions for improvement of the cards. Some of these suggestions concerned the recommendations of how to use the cards. Among these suggestions were to define more roles, to specify them more precisely, and to allow changing cards as often as one likes. One student said that since it is not a real game where “fair play is important”, it should be possible to completely ignore one's own role. The same student said a “wrong role” could prevent members of a group from participating in a discussion when they are not confident about their role. As we have seen earlier, at least one group changed roles during the process and decided to choose roles by themselves in the second round.

One student mentioned as an issue too little time to think. This point clearly merits attention since, as the student reported, some people had already come up with an idea when others were still thinking about their challenges. This relates to the issue mentioned earlier where a student reported that the distraction of ideas raised by others made him forget his own role.

6 Discussion

The TMAP Design Cards presented in this paper are a design tool based on a descriptive framework. To create them, we followed similar approaches by Hornecker (2010) and Lockton (2013) in other domains.

With the evaluation of the TMAP Design Cards by using them in design sessions with students, we identified their potential for *idea finding* and *change thinking*

but also identified issues with *complex terminology*, with certain types of cards and with the recommendations for using them.

When drafting the cards, we used the elements from all four levels of the TMAP Framework on different sides and areas of the cards. For instance, sub-categories became challenges on the front side, and design aspects were turned into suggestions on the backside of a card, in order to allow designers to think about challenges on their own, before turning around a card to read further suggestions. With this decision, we followed a different strategy than Hornecker (2010) and Lockton (2013). Both use single-sided cards and a figure on each card as a design suggestion. Contrary to the TMAP cards, Lockton's cards also included explicit examples of how each design pattern might influence a design decision. According to the results evaluating the TMAP Design Cards, most students used the cards as intended in this respect and did not immediately turn the cards around to read the concrete examples. This particular strategy turned out to have an interesting benefit, as noted below.

As mentioned earlier, users had some problems with the terminology used on the cards, though this may be in part to do with the specialised musical nature of the domain. Neither Hornecker nor Lockton observed a similar issue. A possible improvement could be to reduce or simplify the text or to add explanatory figures.

Generally, some students reported that the cards helped them to find initial ideas and many reported that they helped them to change their thinking later in a design session.

Hornecker observed differences depending on participants' familiarity with the problem setting. For example, she observed good potential for ideation particularly when starting a design session with a well-understood problem or setting. By contrast, she reported that unguided design sessions were less productive. Our students had to find new ideas for technology-mediated audience participation without any strict constraints, apart from the live music setting. Given this, and given Hornecker's experience, it is interesting that while most of our groups found their ideas in an early phase without using the cards, the cards were found to help them to change their thinking and reframe some of their initial design ideas.

The strategy to use two sides, having a challenge on the front side and further suggestions on the back, was reported as useful. This two-sided structure especially helped those students who did not turn around the card to concentrate on the challenge and to create their own ideas.

Inspiration through the cards in relation to the complex terminology split opinion. For some it was disruptive and for others it incentivised thinking (e.g. the manager role).

The TMAP design cards are a contribution to the specific field of audience participation in live music. For HCI this concerns the design of technology to facilitate interaction between artists and their spectators. In particular, we could successfully transfer the principle of design cards to the area of interaction design in live music. Overall, this design approach turned out to be useful for idea finding and change of thinking during design processes. However, we observed issues

with the complexity of music-related terminology as most of our study participants had no particular musical training. This indicates that the different levels of expertise within this interdisciplinary area of design concerning HCI and music needs to be considered more carefully to fully benefit from this card-based design approach.

7 Conclusion

This chapter has explored the creation and evaluation of design cards to support the interaction design and evaluation of technology-mediated audience participation systems and performances. To the best of our knowledge, this is the first card-driven design process devised for music interaction design.

TMAP is a highly challenging area for interaction design which involves taking into account knowledge and views from diverse perspectives and disparate stakeholders.

The evaluation found that the cards helped participants to see designs through other people's eyes, reconsider their views, think about previously unconsidered roles and generate novel ideas. Hallmarks of successful group use of the cards included flexibility in application and self-management of role allocation.

The current methodology and framework provide an empirically-tested basis from which various variations and refinements could be explored, for example finding ways to encourage the evolution of more flexible and self-managed approaches to card use by participants.

The approach described in this chapter offers designers of systems for technology-mediated audience participation a validated tool for exploring the design space and challenging their own assumptions and preconceived ideas.

In one sense, given the particular descriptive framework for TMAP on which it is based, this research is situated within a specialised sub-area of Music and HCI. However, with suitable changes of descriptive framework and workshop tasks, the card-driven design process appears eminently capable of more general application, particularly in other areas of Music and HCI in which diverse perspectives and disparate roles must be taken into account for effective interaction design.

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